PART K
COMPRESSED GAS AND COMPRESSED GAS EQUIPMENT

WAC

WAC 296-24-920 Inspection of compressed gas cylinders.

[Order 73-5, 296-24-920, filed 5/9/73 and order 73-4, 296-24-920, filed 5/7/73.]

WAC 296-24-92001 Definitions.

(1) **High-and low pressure cylinders**. High-pressure cylinders means those cylinders with a marked service pressure of 900 p.s.i. or greater, low-pressure cylinders are those with a marked service pressure of less than 900 p.s.i.

(2) **Minimum allowable wall thickness.** The minimum allowable wall thickness means the minimum thickness required by the specifications under which the cylinder was manufactured.

(3) **Dents.** Dents (in cylinders) means deformations casued by the cylinder coming in contact with a blunt object in such a way that the thickness of metal is not materially impaired.

(4) **Cuts, gouges, or digs.** Cuts, gouges, or digs (in cylinders) means deformations caused by contact with a sharp object in such a way as to cut into or upset the metal of the cylinder, decreasing the wall thickness at that point.

(5) **Corrosion or pitting.** Means corrosion or pitting in cylinders involving the loss of wall thickness by corrosive media.

Note: There are several kinds of pitting or corrosion to be considered.

(6) **Isolated pitting.** Means isolated pits of small cross-section which do not effectively weaken the cylinder wall but are indicative of possible complete penetration and leakage.

Note: Since the pitting is isolated the original wall is essentially intact.

(7) **Line Corrosion.** Means pits which are not isolated but are connected or nearly connected to others in a narrow band or line.

Note: This condition is more serious than isolated pitting. Line corrosion frequently occurs in the area of intersection of the footring and bottom of a cylinder. This is sometimes referred to as "crevice corrosion."

WAC 296-24-92001 (Cont.)

(8) **General corrosion.** Means corrosion which covers considerable surface area of the cylinder.

Note: It reduces the structural strength. It is often difficult to measure or estimate the depth of general corrosion because direct comparison with the original wall cannot always be made. General corrosion is often accompanied by pitting.

(9) **"DOT"** means the U.S. Department of Transportation.
[Order 73-5, 296-24-92001, filed 5/9/73 and Order 73-4, 296-24-92001, filed 5/7/73.]

WAC 296-24-92003 General requirements.

(1) Application.

(a) Each employer shall determine that compressed gas cylinders under the employers control are in a safe condition to the extent that this can be determined by visual, and other inspection required by WAC 296-24-920 through 296-24-92011.

(b) The requirements contained in these standards are not intended to apply to cylinders manufactured under specification DOT (ICC)-3HT (49CFR Ch.1). Separate requirements covering service life and standards for visual inspection of these cylinders are contained in Compressed Gas Association Pamphlet C-8, "Standard for Requalification of ICC-3HT Cylinders."

(2) Quality of inspection. Experience in the inspection of cylinders is an important factor in determining the acceptability of a given cylinder for continued service.

Note: Users lacking this experience and having doubtful cylinders should return them to a manufacturer of the same type of cylinders for reinspection.
[Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-24-92003, filed 7/20/94, effective 9/20/94; Order 73-5, 296-24-92003, filed 5/9/73 and Order 73-4, 296-24-92003, filed 5/7/73.]

WAC 296-24-92005 Inspection of low-pressure cylinders exempt from the hydrostatic test including acetylene cylinders.

(1) Application. This section covers cylinders of the type that are exempt from the hydrostatic retest requirements of the DOT by virtue of their exclusive use in certain noncorrosive gas service. They are not subject to internal corrosion and do not require internal shell inspection.

(2) Preparation for inspection. Rust, scale, caked paint, etc., shall be removed from the exterior surface so that the surface can be adequately observed. Facilities shall be provided for inverting the cylinder to facilitate inspection of the bottom. This is important because experience has shown this area to be the most susceptible to corrosion.

(3) Exterior inspection. Cylinders shall be checked as outlined below for corrosion, general distortion, or any other defect that might indicate a weakness which would render it unfit for service.

(a) To fix corrosion limits for all types, designs, and sizes of cylinders, and include them in this section is not practicable. Cylinders categorized by this section and subsection (1) of this section shall meet the following requirements. Failure to meet any of these requirements is of itself cause for rejection of a cylinder. Rejected cylinders shall be removed from the work place. Rejected cylinders may be returned to the manufacturer for reinspection.

WAC 296-24-92005 (Cont.)

(i) A cylinder shall be rejected when the tare weight is less than ninety-five percent of the original tare weight marked on the cylinder. When determining tare weight, be sure that the cylinder is empty.

(ii) A cylinder shall be rejected when the remaining wall in an area having isolated pitting only is less that one-third of the minimum allowable wall thickness as determined under (b) and (d) of this subsection.

(iii) A cylinder shall be rejected when line corrosion on the cylinder is three inches in length or over and the remaining wall is less than three-fourths of the minimum allowable wall thickness or when line corrosion is less than three inches in length and the remaining wall thickness is less than one-half the minimum allowable wall thickness as determined under (b) through (d) of this sub.sjection.

(iv) A cylinder shall be rejected when the remaining wall in an area of general corrosion is less than one-half of the minimum allowable wall thickness as determined under (b) through (d) of this subsection.

(b) To use the criteria in (a) of this subsection, it is necessary to know the original wall thickness of the cylinder or the minimum allowable wall thickness. Table M-1 lists the minimum allowable wall thickness under DOT specifications (49 CFR Ch.1) for a number of common size low-pressure cylinders.

Cylinder size O.D. x length (inches)	DOT specification marking	Nominal water capacity (pounds	Minimum allowable wall thickness (inches)
15x46	4B240[1]	239	0.128
14 13/16 x 47	4E240	239	.140
14 14/16 x46	4BA240	239	.086
14 11/14 x 28 3/8	4BA240	143	.086
11 29/32 x 32 11/16	4BA240	95	.078
11 29/32 x 18 11/32	4BA240	48	.078

[1] Without longitudinal seam.

(c) When the wall thickness of the cylinder at manufacture in not known, and the actual wall thickness cannot be measured, this cylinder shall be rejected when the inspection reveals that the deepest pit in a general corrosion area exceeds three sixty-fourths inch. This is arrived at by considering that in no case shall the pitting exceed one-half the minimum allowable wall thickness which is 0.064 inch. When a pit measures 0.043 inch (approximately three sixty-fourths inch) in a corrosion area, general corrosion will already have removed 0.021 inch of the original wall and the total pit depth as compared to the initial wall will be 0.064 inch.

(d) When the original wall thickness at manufacture is known, or the actual wall thickness is measured, this thickness less one and one-half times the maximum measured pit depth shall be 0.064 inch or greater. If it is less, the cylinder shall be rejected.

(e) Dents are of concern where the metal deformation is sharp and confined, or where they are near a weld. Where metal deformation is not sharp, dents or larger magnitude can be tolerated.

(f) When denting occurs so than any part of the deformation includes a weld, the maximum allowable dent depth shall be one-fourth inch.

WAC 296-24-92005 (Cont.)

(g) Where denting occurs so that any part of the deformation includes a weld, the cylinder shall be rejected if the depth of the dent is greater than one-tenth of the mean diameter of the dent.

(h) Cuts, gouges, or digs reduce the wall thickness of the cylinder and in addition are considered to be stress raisers. Depth limits are set in these standards; however, cylinders shall be rejected at one-half of the limit set whenever the length of the defect is three inches or more.

(i) When the original wall thickness at manufacture is not known, and the actual wall thickness cannot be measured a cylinder shall be rejected if the cut, gouge, or dig exceeds one-half of the minimum allowable wall thickness as determined under (b) through (d) of this subsection.

(ii) When the original wall thickness at manufacture is known, or the actual wall thickness is measured, a cylinder shall be rejected if the original wall thickness minus the depth of the defect is less than one-half of the minimum allowable wall thickness as determined under (b) through (d) of this subsection.

(i) Leaks can originate from a number of sources, such as defects in a welded or brazed seam, defects at the threaded opening, or from sharp dents, digs, gouges, or pits.

(i) To check for leaks, the cylinder shall be charged and carefully examined. All seams and pressure openings shall be coated with a soap or other suitable solution to detect the escape of gas. Any leakage is cause for rejection.

(ii) Safety relief devices as defined in WAC 296-24-93001(1) shall be tested for leaks before a charged cylinder is shipped from the cylinder filling plant.

(j) After fire damage, cylinders shall be carefully inspected for evidence of exposure to fire.

(i) Common evidences of exposure to fire are:

(A) Charring or burning of the paint or other protective coat.

(B) Burning or sintering of the metal.

(C) Distortion of the cylinder.

(D) Melted out fuse plugs.

(E) Burning or melting of valve.

(ii) The evaluation of fire damage by DOT regulations states that “a cylinder which has been subjected to the action of fire must not again be placed in service until is has been properly reconditioned,” in accordance with 49 CFR 173.34(f). The general intent of this requirement is to remove from service cylinders which have been subject to the action of fire which has changed the metallurgical structure or the strength properties of the steel, or in the case of acetylene cylinders caused breakdown of porous filler. This is normally determined by visual examination as covered above with particular emphasis to the condition of the protective coating. If the protective coating has been burnt off or if the cylinder body is burnt, warped, or distorted, it is assumed that the cylinder has been overheated and 49 CFR 173.34(f) shall be complied with. If, however, the protective coating is only dirtied from smoke or other debris, and is found by examination to be intact underneath, the cylinder shall not be considered affected within the scope of this requirement.

WAC 296-24-92005 (Cont.)

(k) Cylinders are manufactured with a reasonably symmetrical shape. Cylinders which have definite visible bulges shall be removed from service and evaluated. Cylinders shall be rejected when a variation of one percent or more is found in the measured circumferences or in peripheral distances measured from the valve spud to the center seam (of equivalent fixed point).

(l) Cylinder necks shall be examined for serious cracks, folds, and flaws. Neck cracks are normally detected by testing the neck during charging operations with a soap solution.

(m) Cylinder neck threads shall be examined whenever the valve is removed from the cylinder. Cylinders shall be rejected if the required number of effective threads are materially reduced, or if a gas tight seal cannot be obtained by reasonable valving methods. Gages shall be used to measure the number of effective threads.

(n) If the valve is noticeably tilted the cylinder shall be rejected.

(o) The footring and headring of cylinders may become so distorted through service abuse that they no longer perform their functions:

(i) The cause the cylinder to remain stable and upright.

(ii) To protect the valve. Rings shall be examined for distortion; for looseness, and for failure of welds. Appearances may often warrant rejection of the cylinder.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), 296-24-92005, filed 5/15/89, effective 6/30/89; Order 73-5, 296-24-92005, filed 5/9/73 and Order 73-4, 296-24-92005, filed 5/7/73.]

WAC 296-24-92007 Low-pressure cylinders subject to hydrostatic testing.

(1) Application. Cylinders covered in this section are low-pressure cylinders other than those covered in WAC 296-24-92005 through 296-24-92005(3)(o)(ii). They differ essentially from such cylinders in that they require a periodic hydrostatic retest which includes an internal and external examination. Defect limits for the external examination are prescribed in WAC 296-24-92005 through 296-24-92005(3)(o)(ii), with exceptions for aluminum cylinders shown in WAC 296-24-92007(4).

(2) Preparation for inspection. Flammable gas cylinders shall be purged before being examined with a light. Lamps used for flammable gas cylinder inspection shall be explosion proof.

(3) Internal inspection. Cylinders shall be inspected internally at least every time the cylinder is periodically retested. The examination shall be made with a light of sufficient intensity to clearly illuminate the interior walls.

(4) External inspection of aluminum cylinders. The inspection requirements of WAC 296-24-92005 through 296-24-92005(3)(o)(ii) shall be met, except as follows:

(a) Aluminum cylinders shall be rejected when impairment to the surface (corrosion or mechanical defect) exceeds a depth where the remaining wall is less than three-fourths of the minimum allowable wall thickness required by the specification under which the cylinder was manufactured.

(b) Aluminum cylinders subjected to the action of fire shall be removed from service.

[Order 73-5, 296-24-92007, filed 5/9/73 and Order 73-4, 296-24-92007, filed 5/7/73.]

WAC 296-24-92009 High-pressure cylinders.

(1) Application. High-pressure cylinders are those with a marked service pressure of 900 p.s.i. or higher. They are seamless; no welding is permitted. The great bulk of such cylinders are of the 3A or 3AA types under DOT specification (49 CFR Ch. 1).

(2) Preparation for inspection.

(a) Cylinders shall be cleaned for inspection so that the inside and outside surfaces and all conditions can be observed. This shall include removal of scale and caked paint from the exterior and the thorough removal of internal scale. Cylinders with interior coating shall be examined for defects in the coating. If the coating is defective, it shall be removed.

(b) A good inspection light of sufficient intensity to clearly illuminate the interior wall is mandatory for internal inspection. Flammable gas cylinders shall be purged before being examined with a light. Lamps for flammable gas cylinder inspection shall be explosion proof.

(3) Exterior inspection.

(a) To fix corrosion limits for all types, designs, and sizes of cylinders, and include them in this section, is not practicable. Considerable judgment is required in evaluating cylinders fit for service. Experience is a major factor, aside from strength considerations for high pressure cylinders.

(b) When the original wall thickness of the cylinder is not known, and the actual wall thickness cannot be measured, the cylinder shall be rejected if corrosion exceeds one thirty-second inch in depth. This is arrived at by subtracting from the minimum allowable wall at manufacture (0.221 inch), the limiting wall in service (0.195 inch), to give the maximum allowable corrosion limit of 0.026 inch, the equivalent of one thirty-second inch.

(c) When the wall thickness is known, or the actual wall thickness is measured, the difference between this known wall and the limiting value establishes the maximum corrosion figure. The normal hot forged cylinder of this size will have a measured wall of about 0.250 inch. Comparison of this with the limiting wall thickness shows that defects up to about one-sixteenth inch are allowable provided, of course, that the actual wall is measured or is known.

(d) Cylinders with general corrosion are evaluated by subjecting them to a hydrostatic test. Thus, a cylinder with an elastic expansion of 227 cc. or greater shall be rejected. If areas of pronounced pitting are included within the general corrosion, the depth of such pitting should also be measured (with the high spots of the actual surface as a reference plane) and the criteria established in the first example apply. Thus, the maximum corrosion limit would be one thirty-second inch when the wall was not known.

(e) Any defect of appreciable depth having a sharp bottom is a stress raiser and even though a cylinder may be acceptable from a stress standpoint, it is common practice to remove such defects. After any such repair operation, verification of the cylinder strength and structure shall be made by a hydrostatic test of other suitable means.

(f) Dents can be tolerated when the cylinder wall is not deformed excessively or abruptly. Generally speaking, dents are accepted up to a depth of about one-sixteenth inch when the major diameter of the dent is equal to or greater than 32 times the depth of the dent. Sharper dents than this are considered too abrupt and shall require rejection of the cylinder. On small diameter cylinders these general rules may have to be adjusted. Considerations of appearance play a major factor in the evaluation of dents.

WAC 296-24-92009 (Cont.)

(g) Cylinders with arc or torch burns shall be removed from service. Defects of this nature may be recognized by one of the following conditions:

(i) Removal of metal by scarfing or cratering.

(ii) A sentering or burning of the base metal.

(iii) A hardened head affected zone. A simple method for verifying the presence of small arc burns is to file the suspected area. This hardened zone will resist filing as compared to the softer base metal.

(h) Cylinders are normally produced with a symmetrical shape. Cylinders with distinct visual bulges shall be removed from service until the nature of the defect is determined. Some cylinders may have small discontinuities related to the manufacturing process - mushroomed bottoms, offset shoulders, etc. These usually can be identified and are not normally cause for concern.

(i) Cylinders shall be carefully inspected for evidences of exposure to fire. (See WAC 296-24-92005(3)(j).)

(j) Cylinder necks shall be examined for serious cracks, folds and flaws. (See WAC 296-24-92005(3)(l) and (m).)

[Order 73-5, 296-24-92009, filed 5/9/73 and Order 73-4, 296-24-92009, filed 5/7/73.]

WAC 296-24-92011 Internal inspection.

(1) Cylinders shall be inspected internally at least every time the cylinder is periodically retested. This examination shall be made with a light of sufficient intensity to clearly illuminate the interior walls.

(2) A hammer test consists of tapping a cylinder a light blow with a suitably sized hammer. A cylinder emptied of liquid content, with a clean internal surface, standing free, will have a clear ring. Cylinders with internal corrosion with give a duller ring dependent upon the amount of corrosion and accumulation of foreign material. Such cylinders shall be investigated. The hammer test is very sensitive and is an easy, quick, and convenient test that can be made without removing the valve before each charging. It is an invaluable indicator of internal corrosion.

[Order 73-5, 296-24-92011, filed 5/9/73 and Order 73-4, 296-24-92011, filed 5/7/73.]

WAC 296-24-930 Safety relief devices for compressed gas cylinders.

[Order 73-5, 296-24-930, filed 5/9/73 and Order 73-4, 296-24-930, filed 5/7/73.]

WAC 296-24-93001 Definitions.

(1) **Safety relief device.** A “safety relief device” is a device intended to prevent rupture of a cylinder under certain conditions of exposures. (The term as used herein shall include the approach channel, the operating parts, and the discharge channel.)

(2) **Approach channel.** An “approach channel” is the passage or passages through which gas must pass from the cylinder to reach the operating parts of the safety relief device.

(3) **Discharge channel.** A “discharge channel” is the passage or passages beyond the operating parts through which gas must pass to reach the atmosphere exclusive of any piping attached to the outlet of the device.

(4) **Safety relief device channel.** A “safety relief device channel” is the channel through which gas released by operation of the device must pass from the cylinder to the atmosphere exclusive of any piping attached to the inlet or outlet of the device.

WAC 296-24-93001 (Cont.)

(5) **Operating part.** The "operating part" of a safety relief device is the part of a safety relief device that normally closes the safety discharge channel but when removed from this position as a result of action of heat or pressure, or a combination of the two, permits escape of gas from the cylinder.

(6) **Frangible disc.** A "frangible disc" is an operating part in the form of a disc, usually of metal and which is so held as to close the safety relief device channel under normal conditions. The disc is intended to burst at a predetermined pressure to permit the escape of gas.

(7) **Pressure opening.** A "pressure opening" is the orifice against which the frangible disc functions.

(8) **Rated bursting pressure.** A "rated bursting pressure" of a frangible disc is the maximum pressure for which the disc is designed to burst when in contact with the pressure opening for which it was designed when tested.

(9) **Fusible plug.** A "fusible plug" is an operating part in the form of a plug of suitable low melting material, usually a metal alloy, which closes the safety relief device channel under normal conditions and is intended to yield or melt at a predetermined temperature to permit the escape of gas.

(10) **Yield temperature.** The "yield temperature" of a fusible plug is the temperature at which the fusible metal or alloy will yield when tested.

(11) **Reinforced fusible plug.** A "reinforced fusible plug" is a fusible plug consisting of a core of suitable material having a comparatively high yield temperature surrounded by a low-melting point fusible metal of the required yield temperature.

(12) **Combination frangible disc-fusible plug.** A "combination frangible disc-fusible plug" is a frangible disc in combination with a low melting point fusible metal, intended to prevent its bursting at its predetermined bursting pressure unless the temperature also is high enough to cause yielding or melting of the fusible metal.

(13) **Safety relief valve.** A "safety relief valve" is a safety relief device containing an operating part that is held normally in a position closing the safety relief device channel by spring force and is intended to open and to close at predetermined pressures.

(14) **Combination safety relief valve and fusible plug.** A "combination safety relief valve and fusible plug" is a safety relief device utilizing a safety relief valve in combination with a fusible plug. This combination device may be an integral unit or separate units and is intended to open and to close at predetermined pressures or to open at a predetermined temperature.

(15) **Set pressure.** The "set pressure" of a safety relief valve is the pressure marked on the valve and at which it is set to start-to-discharge.

(16) **Start-to-discharge pressure.** The "start-to-discharge pressure" of a safety relief valve is the pressure at which the first bubble appears through a water seal of not over 4 inches in the outlet of the safety relief valve.

(17) **Flow capacity.** The "flow capacity" of a safety relief device is the capacity in cubic feet per minute of free air discharged at the required flow rating pressure.

(18) **Flow rating pressure.** The "flow rating pressure" is the pressure at which a safety relief device is rated for capacity.

(19) **Nonliquefied compressed gas.** A "nonliquefied compressed gas" is a gas, other than a gas in solution which under the charging pressure, is entirely gaseous at a temperature of 70°F.

WAC 296-24-93001 (Cont.)

(20) **Liquefied compressed gas.** A "liquefied compressed gas" is a gas which, under the charging pressure, is partially liquid at a temperature of 70°F. A flammable compressed gas which is normally nonliquefied at 70°F but which is partially liquid under the charging pressure and temperature, shall follow the requirements for liquefied compressed gases.

(21) **Compressed gas in solution.** A "compressed gas in solution" (Acetylene) is a nonliquefied gas which is dissolved in a solvent.

(22) **Pressurized liquid compressed gas.** A "pressurized liquid compressed gas" is a compressed gas other than a compressed gas in solution, which cannot be liquefied at a temperature of 70°F, and which is maintained in the liquid state at a pressure not less than 40 p.s.i.a. by maintaining the gas at a temperature less than 70°F.

(23) **Test pressure of the cylinder.** The "test pressure of the cylinder" is the minimum pressure at which a cylinder must be tested as prescribed in DOT specifications for compressed gas cylinders 41 CFR Ch. 1.

(24) **Free air or free gas.** "Free air" or "free gas" is air or gas measured at a pressure of 14.7 pounds per square inch absolute and a temperature of 60°F.

(25) **DOT regulations.** As used in these standards "DOT regulations" refer to the U.S. Department of Transportation Regulations for Transportation of Explosives and Other Dangerous Articles by Land and Water in Rail Freight, Express and Baggage Services and by Motor Vehicle (Highway) and Water, including Specification for Shipping Containers, Code of Federal Regulations, Title 49, Parts 171 to 178.

[Order 73-5, 296-24-93001, filed 5/9/73 and Order 73-4, 296-24-93001, filed 5/7/73.]

WAC 296-24-93003 General requirements.

(1) Application. Compressed gas cylinder, portable tanks, and cargo tanks shall have pressure relief devices installed and maintained in accordance with Compressed Gas Association Pamphlets S-1.1-1963 and 1965 addenda and S-1.2-1963.

(2) Types of safety relief devices. Types of safety relief devices as covered by this section are designated as follows:

(a) Type CG-1: Frangible disc.

(b) Type CG-2: Fusible plug or reinforced fusible plug utilizing a fusible alloy with yield temperature not over 170°F, nor less than 157°F (165°F nominal).

(c) Type CG-3: Fusible plug or reinforced fusible plug utilizing a fusible alloy with yield temperature not over 220°F, nor less than 208°F (212°F nominal).

(d) Type CG-4: Combination frangible disc-fusible plug, utilizing a fusible alloy with yield temperature not over 170°F, nor less than 157°F (165°F nominal).

(e) Type CG-5: Combination frangible disc-fusible plug, utilizing a fusible alloy with yield temperature not over 220°F, nor less than 208°F (212°F nominal).

(f) Type CG-7: Safety relief valve.

(g) Type CG-8: Combination safety relief valve and fusible plug.

WAC 296-24-93003 (Cont.)

(3) Specifications and tests. All safety relief devices covered by this section shall meet the design, construction, marking and test specification of the "Compressed Air Association Safety Relief Devices Standards Part 1-Cylinders for Compressed Gases: S1.1-1963."

(4) Specific requirements for safety relief devices.

(a) Compressed gas cylinders, which under the regulations of the department of transportation must be equipped with safety relief devices, shall be considered acceptable when equipped with devices of proper construction, location, and discharge capacity under the conditions as prescribed in Table 1 of the Compressed Gas Associations Standard S-1.1-1963.

(b) Only replacement parts or assemblies provided by the manufacturer shall be used unless the advisability of interchange is proved by adequate tests.

(c) When a frangible disc is used with a compressed gas cylinder, the rated bursting pressure of the disc shall not exceed the minimum required test pressure of the cylinder with which the device is used, except for DOT-3E cylinders (49 CFR Ch. 1) the rated bursting pressure of the device shall not exceed 4,500 pounds per square inch gage (p.s.i.g.).

(d) When a safety relief valve is used on a compressed gas cylinder, the flow rating pressure shall not exceed the minimum required test pressure of the cylinder on which the safety relief valve is installed and the reseating pressure shall not be less than the pressure in a normally charged cylinder at 130°F.

(e) When fittings and piping are used on either the upstream or downstream side or both of a safety relief device or devices, the passages shall be so designed that the flow capacity of the safety relief device will not be reduced below the capacity required for the container on which the safety relief device assembly is installed, nor to the extent that the operation of the device could be impaired. Fittings, piping, and method of attachment shall be designed to withstand normal handling and the pressures developed when the device or devices function.

(f) No shutoff valve shall be installed between the safety relief devices and the cylinder.

(5) Maintenance requirements for safety relief devices.

(a) As a precaution to keep cylinder safety relief devices in reliable operating condition, care shall be taken in the handling or storing of compressed gas cylinders to avoid damage. Care shall also be exercised to avoid plugging by paint or other dirt accumulation of safety relief device channels or other parts which could interfere with the functioning of the device. Only qualified personnel shall be allowed to service safety relief devices.

(b) Each time a compressed gas cylinder is received at a point for refilling, all safety relief devices shall be examined externally for corrosion, damage, plugging of external safety relief device channels, and mechanical defects such as leakage or extrusion of fusible metal. If there is any doubt regarding the suitability of the safety relief device for service the cylinder shall not be filled until it is equipped with a suitable device.

[Order 73-5, 296-24-93003, filed 5/9/73 and Order 73-4, 296-24-93003, filed 5/7/73.]

WAC 296-24-935 Safety relief devices for cargo and portable tanks storing compressed gases.

[Order 73-5, 296-24-935, filed 5/9/73 and Order 73-4, 296-24-935, filed 5/7/73.]

WAC 296-24-93501 Definitions.

(1) **Cargo tank.** A "cargo tank" means any container designed to be permanently attached to any motor vehicle or other highway vehicle and in which is to be transported any compressed gas. The term "cargo tank" shall not be construed to include any tank used solely for the purpose of supplying fuel for the propulsion of the vehicle or containers fabricated under specifications for cylinders.

(2) **Portable tank.** A "portable tank" means any container designed primarily to be temporarily attached to a motor vehicle, other vehicle, railroad car other than tank car, or marine vessel, and equipped with skids, mountings, or accessories to facilitate handling of the container by mechanical means, in which is to be transported any compressed gas. The term "portable tank" shall not be construed to include any cargo tank, any tank car tank or any tank of the DOT-106A and DOT-110A-W type.

(3) **Safety relief device.** A "safety relief device" means a device intended to prevent rupture of a container under certain conditions of exposure.

(4) **Safety relief valve.** A "safety relief valve" means a safety relief device containing an operating part that is held normally in a position closing the safety relief device channel by spring force and is intended to open and to close at predetermined pressures.

(5) **Set Pressure.** The "set pressure" of a safety relief valve is the pressure marked on the valve and at which the valve is set to start-to-discharge.

(6) **Start-to-discharge pressure.** The "start-to-discharge pressure" of a safety relief valve is the pressure at which the first bubble appears through a water seal of not over 4 inches on the outlet of the valve.

Note: When the nature of the service requires the use of a metal-to-metal seat safety relief valve, with or without secondary sealing means, the start-to-discharge pressure may be considered the pressure at which an audible discharge occurs.

(7) **Resealing pressure.** The "resealing pressure" of a safety relief valve is the pressure at which leakage ceases through a water seal of not over 4 inches on the outlet of the valve.

(8) **Flow capacity.** The "flow capacity" of a safety relief device is the capacity in cubic feet per minute of free air discharged at the required flow rating pressure.

(9) **Flow rating pressure.** The "flow rating pressure" means the pressure at which a safety relief device is rated for capacity.

(10) **Free air or free gas.** "Free air" or "free gas" means air or gas measured at a pressure of 14.7 pounds per square inch absolute and a temperature of 60°F.

(11) **Frangible disc.** A "frangible disc" means a safety relief device in the form of a disc, usually of metal, which is so held as to close the safety relief device channel under normal conditions. The disc is intended to burst at a predetermined pressure to permit the escape of gas.

(12) **Fusible plug.** A "fusible plug" means a safety relief device in the form of a plug of suitable low-melting material, usually a metal alloy, which closes the safety relief device channel under normal conditions and is intended to yield or melt at a predetermined temperature to permit the escape of gas.

(13) **DOT design pressure.** The "DOT design pressure" is identical to the term "maximum allowable working pressure" as used in the "code" and is the maximum gage pressure at the top of the tank in its operating position. To determine the minimum permissible thickness of physical characteristics of the different parts of the vessel, the static head of the lading shall be added to the DOT design pressure to determine the thickness of any specific part of the vessel. If vacuum insulation is used, the liquid container shall be designed for a pressure of 15 p.s.i. more than DOT design pressure, plus static head of the lading.

WAC 296-24-93501 (Cont.)

Exception: *For containers constructed in accordance with paragraph U-68 or U-69 of section VIII of the ASME Boiler and Pressure Vessel Code, 1949 Edition, the maximum allowable working pressure for the purpose of these standards is considered to be 125 percent of the design pressure as provided in 49 CFR 173.315 of DOT regulations.*

(14) **Code.** "Code" is defined as paragraph U-68, U-69, U-200, or U-201 of section VIII of the Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers, 1949 Edition, or section VIII of the Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers, 1950, 1952, 1956, 1959, and 1962 Editions; or the Code for Unfired Pressure Vessels for Petroleum Liquids and Gases of the American Petroleum Institute and the American Society of Mechanical Engineers (API-ASME), 1951, Edition.

(15) **DOT Regulations.** The "DOT regulations" refer to Department of Transportation Regulations for Transportation of Explosives and other Dangerous Articles by Land and Water in Rail Freight, Express and Baggage Services and by Motor Vehicle (Highway) and Water, including Specifications for Shipping Containers, Code of Federal Regulations, Title 49, Parts 171 to 178.

[Order 73-5, 296-24-93501, filed 5/9/73 and Order 73-4, 296-24-93501, filed 5/7/73.]

WAC 296-24-93503 General requirements.

(1) Application. See WAC 296-24-93003(1).

(2) Specifications and tests. All safety relief devices covered by these standards shall meet the design, construction, marking and test specifications of the "Compressed Gas Association Safety Relief Device Standards Part 2-Cargo and Portable Tanks for Compressed Gases: S-1.2-1963."

(3) Specific requirements for safety relief devices.

(a) Each container shall be provided with one or more safety relief devices which, unless otherwise specified, shall be safety relief valves of the spring-loaded type.

(b) Safety relief valves shall be set to start-to-discharge at a pressure not in excess of 110 percent of the DOT design pressure of the container nor less than the DOT design pressure of the container except as follows:

(i) If an overdesigned container is used, the set pressure of the safety relief valve may be between the minimum required DOT design pressure for the lading and 110 percent of the DOT design pressure of the container used.

(ii) For sulfur dioxide containers, a minimum set pressure of 120 and 110 p.s.i.g. is permitted for the 150 and 125 p.s.i.g. DOT design pressure containers, respectively.

(iii) For carbon dioxide (refrigerated), nitrous oxide (refrigerated), and pressurized liquid argon, nitrogen and oxygen, there shall be no minimum set pressure.

(iv) For butadiene, inhibited, and liquefied petroleum gas containers, a minimum set pressure of 90 percent of the minimum design pressure permitted to these ladings may be used.

(v) For containers constructed in accord with paragraph U-68 or U-69 of the Code 1949 Edition, the set pressure marked on the safety relief valve may be 125 percent of the original DOT design pressure of the container.

(c) Only replacement parts or assemblies provided by the manufacturer of the device shall be used unless the suitability of interchange is proved by adequate tests.

WAC 296-24-93503 (Cont.)

(d) Safety relief valves shall have direct communication with the vapor space of the container.

(e) Any portion of liquid piping or hose which at any time may be closed at each end must be provided with a safety relief device to prevent excessive pressure.

(f) The additional restrictions of this subdivision apply to safety relief devices on containers for carbon dioxide or nitrous oxide which are shipped in refrigerated and insulated containers. The maximum operating pressure in the container may be regulated by the use of one or more pressure controlling devices, which devices shall not be in lieu of the safety relief valve required in WAC 296-24-93503(3)(a).

(g) All safety relief devices shall be so installed and located that the cooling effect of the contents will not prevent the effective operation of the device.

(h) In addition to the safety relief valves required by WAC 296-24-93503(3)(a) each container for carbon dioxide may be equipped with one or more frangible disc safety relief devices of suitable design set to function at a pressure not exceeding two times the DOT design pressure of the container.

(i) Subject to conditions of 49 CFR 173.315(a)(1) (DOT regulations) for methyl chloride and sulfur dioxide optional portable tanks of 225 p.s.i.g. minimum DOT design pressure, one or more fusible plugs approved by the Bureau of Explosives, 50 "F" Street Northwest, Washington, D.C. 20001, may be used in lieu of safety relief valves of the spring-loaded type. If the container is over 30 inches long a safety relief device having the total required flow capacity must be at both ends.

(j) When storage containers for liquefied petroleum gas are permitted to be shipped in accordance with 49 CFR 173.315(j) (DOT regulations), they must be equipped with safety relief devices in compliance with the requirements for safety relief devices on above-ground containers as specified in the National Fire Protection Association Pamphlet No. 58-1969 "Standard for the Storage and Handling of Liquefied Petroleum Gases."

(k) When containers are filled by pumping equipment which has a discharge capacity in excess of the capacity of the container safety relief devices, and which is capable of producing pressures in excess of DOT design pressure of the container, precautions should be taken to prevent the development of pressures in the container in excess of 120 percent of its DOT design pressure. This may be done by providing additional capacity of the safety relief valves on the container, by providing a bypass on the pump discharge, or by any other suitable method.

(l) This additional requirement applies to safety relief devices on containers for liquefied hydrogen and pressurized liquid argon, nitrogen, and oxygen. The liquid container shall be protected by one or more safety relief valves and one or more frangible discs.

(m) Safety relief devices shall be arranged to discharge unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container. Safety relief devices shall be arranged to discharge upward except this is not required for carbon dioxide, nitrous oxide, and pressurized liquid argon, nitrogen, and oxygen.

(n) No shutoff valves shall be installed between the safety relief devices and the container except, in cases where two or more safety relief devices are installed on the same container, a shutoff valve may be used where the arrangement of the shutoff valve or valves in such as always to insure full required capacity flow through at least one safety relief device.

WAC 296-24-93503 (Cont.)

(4) Maintenance requirements for safety relief devices.

(a) Care shall be exercised to avoid damage to safety relief devices. Care shall also be exercised to avoid plugging by paint or other dirt accumulations of safety relief device channels or other parts which could interfere with the functioning of the device.

(b) Only qualified personnel shall be allowed to service safety relief devices. Any servicing or repairs which require retesting of safety relief valves shall be done only by or after consultation with the valve manufacturer.

(c) Safety relief devices periodically shall be examined externally for corrosion damage, plugging of external safety relief device channels, and mechanical defects such as leakage or extrusion of fusible metal. Valves equipped with secondary resilient seals shall have the seals inspected periodically. If there is any doubt regarding the suitability of the safety relief device for service the container shall not be filled until it is equipped with a suitable safety relief device.

[Statutory Authority: Chapter 49.17 RCW. 94-15096 (Order 94-07), 296-24-93503, filed 7/20/94, effective 9/20/94; [Order 73-5, 296-24-93503, filed 5/9/73 and Order 73-4, 296-24-93503, filed 5/7/73.]

WAC 296-24-940 Air receivers.

[Order 73-5, 296-24-92011, filed 5/9/73 and Order 73-4, 296-24-92011, filed 5/7/73.]

WAC 296-24-94001 General requirements.

(1) Application. These standards apply to compressed air receivers, and other equipment used in providing and utilizing compressed air for performing operations such as cleaning, drilling, hoisting, and chipping. On the other hand, however, this section does not deal with the special problems created by using compressed air to convey materials nor the problems created when working in compressed air as in tunnels and caissons. These standards are not intended to apply to compressed air machinery and equipment used on transportation vehicles such as steam railroad cars, electric railway cars, and automotive equipment.

(2) New and existing equipment.

(a) All new air receivers installed after the effective date of these standards shall be constructed in accordance with the 1968 Edition of the ASME Boiler and Pressure Vessel Code, section VIII.

(b) All safety valves used shall be constructed, installed, and maintained in accordance with the ASME Boiler and Pressure Vessel Code, section VIII Edition 1968.

[Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-24-94001, filed 7/20/94, effective 9/20/94; [Order 73-5, 296-24-94001, filed 5/9/73 and Order 73-4, 296-24-94001, filed 5/7/73.]

WAC 296-24-94003 Installation and equipment requirements.

(1) Installation. Air receivers shall be so installed that all drains, handholes, and manholes therein are easily accessible. Air receivers should be supported with sufficient clearance to permit a complete external inspection and to avoid corrosion of external surfaces. Under no circumstances shall an air receiver be buried undergound or located in an inaccessible place. The receiver should be located as close to the compressor or after-cooler as is possible in order to keep the discharge pipe short.

WAC 296-24-94003

(2) Drains and traps. All air receivers having an internal and external operating pressure exceeding 15 psi with no limitation on size, and air receivers having an inside diameter exceeding six inches, with no limitation on pressure, if subject to corrosion, shall be supplied with a drain pipe and valve at the lowest point in the vessel; or a pipe may be used extending inward from any other location to within one-quarter inch of the lowest point. Adequate automatic traps may be installed in addition to drain valves. The drain valve on the air receiver shall be opened and the receiver completely drained frequently and at such intervals as to prevent the accumulation of oil and water in the receiver.

(3) Gages and valves.

(a) Every air receiver shall be equipped with an indicating pressure gage (so located as to be readily visible) and with one or more spring-loaded safety valves. The total relieving capacity of such safety valves shall be such as to prevent pressure in the receiver from exceeding the maximum allowable working pressure of the receiver by more than 10 percent.

(b) No valve of any type shall be placed between the air receiver and its safety valve or valves.

(c) Safety appliances, such as safety valves, indicating devices and controlling devices, shall be constructed, located, and installed so that they cannot be readily rendered inoperative by any means, including the elements.

(d) All safety valves shall be tested frequently and at regular intervals to determine whether they are in good operating condition.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), 296-24-94003, filed 5/15/89, effective 6/30/89; [Order 73-5, 296-24-94003, filed 5/9/73 and Order 73-4, 296-24-94003, filed 5/7/73.]